REMARKS

The final Office Action of December 15, 2008 has been carefully reviewed and this response addresses the Examiner's concerns.

I. STATUS OF THE CLAIMS

Claims 42, 47, 48, 50-52, 68, and 71 are currently pending in the application.

Claims 1-41, 43-46, 49, 53-67 and 69-70 have been cancelled.

Claims 42, 47, 48, 50-52, 68, and 71 were rejected under 35 USC §102(b) as being anticipated by, or, in the alternative, under 35 USC §103(a), as being obvious in light of Loeb (US Patent 3,906,250).

Claims 42, 47-48, 50-52, 68, and 71 were rejected under 35 USC § 102(b), as being anticipated by, or, in the alternative, under 35 USC § 103(a), as being unpatentable over the German patent 3121968 ("DE" or "the DE reference").

II. REJECTION OF CLAIMS 42, 47,48, 50-52, 68 AND 71 UNDER 35 USC §102(b)/103(a) IN VIEW OF LOEB (US PATENT 3,906,250)

Claims 42, 47-48, 50-52, 68, and 71 have been rejected under 35 USC §102(b)/103(a) as being anticipated by or obvious in light of Loeb (US Patent 3,906,250).

The Examiner once again alleges that:

> Loeb teaches (see figures) a method of producing energy from a system having a semipermeable barrier separating a pressure chamber and a solvent chamber, wherein the pressure chamber has a solution (sea water) and solvent chamber has a solvent (river water), the solvent flows from the solvent chamber to the pressure chamber across the membrane, and the solvent chamber has a reduced pressure or vacuum. See also Figure 11, which is a closed system with the solvent chamber having only inflow, wherein the solvent chamber is at zero pressure. The solute solution is evaporated with external heat (like solar) in a third chamber—see figure 6 for example—and the solute is recycled as a concentrated solution.
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> With respect to the limitation, "utilizing the semi-permeable barrier to restrict solute from flowing into the first chamber while allowing the solvent to flow into the second chamber as the solvent flows from the first chamber into the second chamber a void is created in the first chamber such that a vacuum develops in the first chamber and increases the pressure in the diluted solute solution in the second chamber," the creation of the void and the increase in pressure in the

> diluted solution in the second chamber are inherent in the process of natural osmosis and are not patentable process steps....
>
> With respect to claim 50, a displacement of an object such as a piston, is implied in the reference to a piston in column 11, lines 37-59. The solvent chamber is pressurized by pumps.

Further, the Examiner states that "periodically applying can mean anything from occasional start and stop to a reciprocating system, and such schemes of energy conversion are within the capability of one of ordinary skill in the art to design."

Since substantially all of the above comments by the Examiner have already been addressed by Applicant in the response filed December 1, 2008, Applicant incorporates herein, in its entirety, the remarks provided in the response filed by Applicant on December 1, 2008. Applicant addresses at this time below those allegations which appear to be new as well as the comments that the Examiner has addressed to Applicant's arguments and Declarations.

With respect to the Examiner's comments related to "Periodically applying can mean anything..." this is an incorrect statement since no where in Loeb does Loeb speak of a periodic application or removal of pressure. In fact, on the contrary, Loeb uses a continuous flow of solvent and solute and relies on an increase in volume rather than as Applicant claims "periodically applying and removing the increased pressure to drive a member which produces a movement from which work can be extracted." (Independent Claim 42) or "... substantial linear displacement of the object." (Independent claim 50)

In order to further clarify why Loeb (and the DE reference) does not periodically apply and remove pressure, Applicant refers the Examiner to the Figs. of Loeb. In particular, the pressure retarded osmosis system of Loeb is described in greatest detail with respect to Figs. 1, 2a, 2b, 3, 3a, 4, 4a, 5, and 6. In particular, each of these figures indicates that an external hydraulic pressure P is applied to the surface of the sea water 6 via a pump 16, 26, 66, or 36. This pressure is used to slow the flux of the permeant, fresh water, into the sea water, see Loeb, Eqs 1 and 2. This is necessary in Loeb, and the DE reference, to allow the increased volume, ΔV to be used to provide the additional energy to drive the turbine 17, 27, 67, and 37, 47, and 57. Clearly, the pressure retarded osmosis system of Loeb (and the DE reference) of using continuous flow are different than Applicant's claimed inventions and methodology.

It is important to note that the term "periodically" is not used in the Loeb patent at all. On the other hand, the Loeb system is described as a continuous system in the brief description of the drawings for Figs. 3 and 4, see Loeb, col. 3, lines 19-26. The Loeb patent also uses the term continuous in the description accompanying Figs. 2a and 2b, see Loeb col. 4, lines 45-53. In addition, the Loeb patent describes the process as continuous in the description of Figs. 3 and 3a, see Loeb, col. 4, lines 56-60. In addition, it is clear when discussing the operation of the pressure retarded osmosis system or apparatus, that both the brine and the river water both have inlets and outlet, See Figs. 3, 3a, 4, 4a, 5, 5a, and 6.

Loeb's patent of using continuous flow in a pressure retarded osmosis system is in stark contrast to Applicant's claimed invention of "providing a sealed, first chamber; providing a sealed second chamber;...periodically applying and removing the increased pressure...." This distinction between the large volume of Loeb and the DE reference is important. For example in Loeb "A volume $(V+\Delta V)$ m^3 of mixed solution is sent to the hydroturbine 126 at a pressure of Patm. Thus the hydroturbine delivers $P(V+\Delta V)$ m^3 of work (via the connection 129) in the course of reducing the pressure of the mixed solution of zero. The new output of work is equal to the difference between the output from the hydroturbine and the input to the pump, i.e., the net work is $(P\Delta V)$ m^3 atm. It is important to understand that net work is obtained only from ΔV, the volume of permeant liquid passing through the membranes" See Loeb, col. 12, lines 41-54.

It is clear that a major distinction between Applicant's claimed invention and the Loeb and the DE reference resides in Applicant providing a pair of sealed containers which cause the (osmotic) pressure to increase as the solvent passes through the membrane. Applicants claimed invention produces useable energy output when pressure is periodically applied and removed from the pressure chamber as claimed. These steps are clearly lacking in Loeb (and the DE) reference.

Because the above claimed method steps are lacking in Loeb, Applicant respectfully contends that an anticipation rejection under 35 USC 102 is inappropriate. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987); MPEP 2131.

The Examiner also rejects the claims as obvious under 35 USC 103 without the application of a secondary reference but merely on the contents of Loeb, which Applicant, based on the remarks provided herein as well as Applicant's prior remarks, clearly establish are opposed to the teaching of Applicant's claimed invention.

Applicant contends that any alteration of the Loeb patent, as in a 35 U.S.C. 103 rejection, in an attempt to meet Applicant's claimed invention of periodically applying and removing pressure and/or providing sealed chambers would render the intended operation of Loeb (and the DE reference) contrary to Loeb's intended purpose since Loeb relies on volume and continuous flow. Even if the Examiner found a reference which taught the deficiencies of Loeb, such a combination would be inappropriate under 35 USC 103 since "If when combined, the references "would produce a seemingly inoperative device," then they teach away from their combination. In re Sponnoble, 56 C.C.P.A. 823, 405 F.2d 578, 587, 160 U.S.P.Q. (BNA) 237, 244 (CCPA 1969); see also In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. (BNA) 1125, 1127 (Fed. Cir. 1984) (finding no suggestion to modify a prior art device where the modification would render the device inoperable for its intended purpose)" (as cited in *Tec-Air Inc. v. Denso Manufacturing*, 192 F.3d 1353, 1360 (Fed. Cir. 1999).) In *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007), the Court identified "teaching away" as a strong indicator of nonobviousness. The teachings of Loeb teach away from Applicant's claimed limitations as noted above and a *prima facie* case of obviousness of the Applicant's invention has not been established.

Based on the above, Applicant respectfully states that claims 42, 47-48, 50-52, 68, and 71 are not anticipated by nor obvious over Loeb since Loeb does not describe nor teach providing sealed containers or periodic application and removal of pressure.

III. REJECTION OF CLAIMS 42, 47-48, 50-52, 68, AND 71 UNDER 35 USC §102 OR IN THE ALTERNATIVE 35 USC §103(A) IN VIEW OF DE 3121968

Claims 42, 47, 48, 50-52, 68, and 71 are rejected under 35 USC §102 or alternatively under 35 USC §103(a) as being anticipated or obvious over the German patent 3121968 ("DE" or "the DE reference"). The Examiner once again asserts that:

> DE teaches a method of pressurizing a solute solution and converting the pressure to energy (by a turbine or by a reciprocating machine, which is a piston machine: see claim 22, page 8 and 28, page 9 of the English translation of the reference; piston in the reciprocating machine has linear displacement) using a solvent by passing the solvent across into the solution through a semi permeable membrane – see figures. The solution is exhausted after the pressure is converted to energy as claimed. Solvent chamber pressure reduces due to loss of solvent by osmosis, which would inherently create a loss of pressure, or vacuum. The solvent chamber (5) is pressurized by a pump - see figure 1, pump 22....
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> DE teaches solvent recycle; and the process of evaporation can be optimally selected from the various available methods - see page 16-20 of the English translation (especially, page 18) - including air circulation, heat pump, and solar energy. Using vacuum for evaporation, particularly at ambient temperature, is known in the art. Even though the reference does not explicitly teach a third chamber, it is implied in terms of evaporation ponds or evaporators and condenser required in the various recycling schemes contemplated by the reference, which include both solvent and concentrated solute solution. [Emphasis added]

Further, the Examiner states that "Periodically applying and removing the increased pressure to drive a member to produce work can mean anything from occasional start and stop of a system to a reciprocating system.

Since substantially all of the above comments by the Examiner with respect to the DE reference have already been addressed by Applicant in the response filed December 1, 2008 Applicant incorporates herein, in its entirety, the remarks provided in the response filed December 1, 2008. Applicant addresses herein those allegations which appear to be new as well as the comments that the Examiner has addressed to Applicant's arguments and Declarations.

In order to further clarify why the German (DE) reference does not periodically apply and remove pressure, Applicant refers the Examiner to Figs. 1-5 of the German reference. In particular, although not specifically labeled as pressure retarded osmosis the fact is that the German reference applies an external hydraulic pressure to the sea water as does Loeb. Thus, the German reference and Loeb operate in very similar manners. In particular, each of these figures indicates that an external hydraulic pressure P is applied to the surface of the sea water via a pump. This pressure is used to slow the flux of the permeant, fresh water, into the sea water. . This is necessary in the German reference, to allow the increased volume, ΔV to be used to provide the additional energy to drive the turbine. The only mention in the German

patent of a reciprocating machine such as a piston is as an alternative dependence in two claims. There is no further explanation in the translated German patent as to how to effect such reciprocating action. As can be seen from Applicant's detailed remarks such reciprocation is not explained in the German patent and it is Applicant's contention that such reciprocation in the German patent without a further explanation does not meet the periodic application and removal of increased pressure as claimed by Applicant. No where in the German patent is such periodic application and removal of pressure described.

With respect to the Examiner's comments related to "Periodically can mean anything..." this is an incorrect statement since no where in the DE reference does it speak of a periodic application of pressure. In fact, on the contrary the DE reference uses a continuous flow of solvent and solute and relies on an increase in volume rather than as Applicant claims "periodically applying and removing the increased pressure ."

As with Loeb, it is important to note that the term "periodically" is not used in the DE patent at all. Throughout the DE reference, the description refers to a liquid with a higher concentration that flows through one of the partial chambers and a liquid with a lower concentration flows through the other partial chamber. See DE reference, page 2 and 3. The Figures and description show that both the high concentration and low concentration fluids have inlets and outlets to allow the continuous flow of both the high concentration and low concentration flows past one another. As in the Loeb reference discussed above, the DE reference provides work via the increase in volume of the fluid in a continuous manner. This is in stark contrast to Applicant's claimed invention of "providing a sealed first chamber;" and "providing a sealed second chamber."

The same distinction exists in the DE reference as in Loeb. See DE reference, page 22. It is important to understand that net work is obtained only from ΔV, the volume of permeant liquid passing through the membranes" See the mathematical description provided in the DE reference, pages 22-31 in which it is clear that the increase in energy is due to the increase in the amount and quantity Q_T. Applicant set forth in the claims providing sealed containers. This causes the osmotic pressure to increase as the solvent passes through the membrane. Applicants claimed invention produces useable energy output when pressure is periodically applied and removed from the pressure chamber. These steps are clearly lacking in the DE reference.

Because the above claimed method steps are lacking in the German patent, Applicant respectfully contends that an anticipation rejection under 35 USC 102 is inappropriate. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987); MPEP 2131.

The Examiner also rejects the claims as obvious under 35 USC 103 without the application of a secondary reference but merely on the contents of the German patent, which Applicant, based on the remarks provided herein as well as Applicant's prior remarks, clearly establish are opposed to the teaching of Applicant's claimed invention.

Applicant contends that any alteration of the German patent, as in a 35 U.S.C. 103 rejection, in an attempt to meet Applicant's claimed invention of periodically applying and removing pressure and/or providing sealed chambers would render the intended operation of the German patent contrary to its intended purpose since the German patent, as in Loeb, relies on volume and continuous flow. Even if the Examiner found a reference which taught the deficiencies of the German patent, such a combination would be inappropriate under 35 USC 103 since "If when combined, the references "would produce a seemingly inoperative device," then they teach away from their combination. In re Sponnoble, 56 C.C.P.A. 823, 405 F.2d 578, 587, 160 U.S.P.Q. (BNA) 237, 244 (CCPA 1969); see also In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. (BNA) 1125, 1127 (Fed. Cir. 1984) (finding no suggestion to modify a prior art device where the modification would render the device inoperable for its intended purpose)" (as cited in *Tec-Air Inc. v. Denso Manufacturing*, 192 F.3d 1353, 1360 (Fed. Cir. 1999).) In *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007), the Court identified "teaching away" as a strong indicator of nonobviousness. The teachings of the German patent teach away from Applicant's claimed limitations as noted above and a *prima facie* case of obviousness of the Applicant's invention has not been established.

Based on the above, Applicant respectfully states that claims 42, 47-48, 50-52, 68, and 71 are neither anticipated by or obvious over the DE reference since the DE reference

does not describe nor teach providing sealed containers or periodic application and removal of pressure.

IV. REBUTTAL TO THE EXAMINER'S COMMENTS WITH RESPECT TO THE PREVIOUSLY SUBMITTED DECLARATIONS

With respect to the Examiners comments with respect to Dr. McGimspsey's Declaration starting on page 5 of the Final Office Action, the Examiner has responded to the McGimpsey Declaration.

In the Examiner's remarks, the Examiner points out that he "sees no difference in the stated principles other than one (the references) being large and the other (applicant's) implied as being small. Contrary to the Examiner's statement, the size of the system is not the issue here but rather that the references (Loeb and the DE reference) are operating in a continuous fashion, i.e., with an open system while Applicant's invention describes and claims a system providing sealed chambers. While the Examiner is correct in pointing out the similarity between the schematic drawings of the references and Applicant's drawings and their basic of structural detail, it is clear from the specification that the Applicant refers to sealed chambers in the specification and claims; while the references do not. That is, the specification of Applicant's invention provides structural details not provided by the schematics and the specifications of the references. This is a critical difference and it is not obvious to add Applicant's material to the references since the references and Applicant's claimed invention function differently.

Also, the Examiner again raises the point that the references teach sealed containers. However, again the sealed nature of the containers cannot be inferred from the drawings of the references as there is no description or teaching in the specifications of sealed containers in either the Loeb reference or the DE reference. The references do not have any mention of sealed containers while Applicant's specification and claims clearly do.

The Examiner further contends that work is pressure multiplied by the volume displaced. This is correct. However, this is not significant in the rejection of the claims since the Applicant is not claiming patentability in the creation of work by the displacement of a piston. Patentability also resides on the process of using a reciprocating system by Applicant. The

references use continuous systems and do not make use of linear displacement as set forth in claim 50. Again the differences between the claimed invention and the references is not obvious.

The Examiner's next comments relate to osmotic pressure and hydrostatic pressure of the pump provided for in both Loeb and the DE reference. The Examiner calculates work output based on the pressure differential and volume change, but is using the hydrostatic pressure in the calculation, not the osmotic pressure. Thus, we are unable to follow the calculations and this line of reasoning.

Finally, the Examiner has not established that either Loeb or the German patents deal with periodically applying and removing the increased pressure as claimed by Applicant.

V. FURTHER RESPONSE TO ARGUMENTS

The Examiner contends in his response to Applicant's arguments that any osmotic action would result in a vacuum being created. This is incorrect. For example in natural systems, osmotic flow across a cell membrane cannot result in a vacuum being created as a constant supply of solvent and solute are provided for by constantly flowing into and out of the system, just as in the Loeb reference and the DE reference. In contrast, the claimed invention has sealed containers, thus creating a fixed volume and contrary to the references, in Applicant's invention once the system is filled with solvent and solute, any movement through the system will shift the volume of fluid in the system from one sealed container to the other. Because the containers are sealed, there must be a vacuum created in the container that loses fluid.

In addition, contrary to the Examiner's argument that "...any vacuum or void in the first chamber would stop the system from functioning because it will starve for solvent – for the system to work there has to be a steady supply of solvent," the invention conveys that there is a supply of solvent in the system. The solvent solution is always maintained in contact with one side of the semipermeable membrane surface. The solvent molecules in the solution are in constant motion, and a portion of them at any one time have a trajectory through the pores in the semipermeable membrane and pass into the second chamber unaffected by the vacuum above the solvent surface. The pressure in the sealed second chamber will continue to build simultaneously as the vacuum develops in the first chamber. The solvent in the first chamber is kept in constant contact with the first chamber side of the semipermeable membrane. At some

time during operation of the claimed invention, the solvent in the first chamber will begin to deplete. At this time a valve closes the first chamber that is low in solvent and another valve opens a separate first chamber full of solvent that is used to replenish the solvent fluid both in terms of chemical composition and in terms of fluid volume as well. In this way the claimed process may continue.

In summary, in Applicant's claimed invention through the use of sealed containers solvent flows into a dilute solute solution and causes the generation of pressure that can be converted to useful work. The Loeb and German patents do not use sealed containers nor the periodic application and removal of pressure, and their use of open containers is inherently inefficient.

Osmotic pressure is the pressure that is generated in a sealed container as the result of the flow of pure solvent across a semi-permeable membrane into a solute solutution. The second law of thermodynamics confirms that the pure solvent will flow spontaneously into the solution. If the container is sealed, this will result in a pressure change in the container. Solvent will continue to flow until the hydrostatic pressure in the sealed container is equal to the osmotic pressure. In effect, the solvent flows into the solution against a pressure gradient. For "equilibrium" to be reached (steady state, not a thermodynamic equilibrium) the "activity" of the pure solvent and solution must be equal and this is achieved by an imbalance in pressure between the pure solvent side of the membrane and the solution side of the membrane. It is the hydrostatic pressure created by the flow of solvent into the sealed chamber that can be 'harvested' to do mechanical work. Applicant's claimed invention is a direct and efficient way to cause mechanical work to flow (the correct thermodynamics terminology refers to work flow), by having the flow of pure solvent into a sealed container and then release of the pressure, as in a reciprocating system, since this allows the maximum increase in pressure. Neither Loeb nor the German patents deal with sealed containers, their systems are based on continuous flow.

Further, in response to arguments and in describing Loeb's and DE's system the Examiner discusses the pressures produced by flow of solvent through the membrane and by the mechanical pump in pumping the solution through the chamber. Clearly, as the Examiner states, in a sealed container and at "equilibrium" the flow of pure solvent through the membrane will cause an increase in hydrostatic pressure that is equal to the osmotic pressure. Whether the

osmotic pressure is 470 atm in such a system, as stated, is dependent on the concentration of solute on the solute side of the membrane.

The key point is that Loeb and the German patents do not use sealed containers. As the Examiner points out, Loeb/DE are pumping solute solution through the solution chamber. Loeb/DE do this because the higher the solute concentration that one can maintain, the higher the hydrostatic pressure that is produced. If they did not pump the solution through the chamber, the pure solvent that passes into the solute chamber would dilute the solute, lower the concentration and reduce the hydrostatic pressure. In order to pump the solution through the chamber, thereby maintaining the gradient, the chamber cannot be sealed in Loeb/DE – it must be open. This analysis is clear from the lowered hydrostatic pressure in the solute chamber – 255 atm versus the theoretical value of 470 atm as quoted by the Examiner.

Another point, the Examiner states the work output of the system at the turbine is equal to the difference in pressures between the high pressure side of the turbine and the low pressure side of the turbine (in the example cited in Loeb, this is 255-7 = 248 atm) multiplied by the flow rate ($V+\Delta V$). The net work, however, as Loeb states in the explanation of Figure 9, is dependent only on the incremental volume caused by flow of solvent through the membrane (ΔV). The Examiner states that V is small compared to ($V+ \Delta V$). In the Loeb example (Figure 11), this is clearly not the case. ΔV is smaller than V and V is therefore comparable in magnitude to $V+. \Delta V$. The point is that it is necessary for Loeb (and the DE patent) to relatively rapidly replenish the high solute side of the membrane, which in turn requires considerable energy from the mechanical pump, in turn decreasing the net work produced by the system.

The Examiner refers to the vacuum in Applicant's system that results from flow of solvent across the membrane. The vacuum results from the sealed nature of the container. In a reciprocating system, as claimed, this vacuum can be used to induce solvent flow, potentially increasing the overall efficiency of the system during operation.

VI. CONCLUSION

Applicant made a diligent effort to place the claims in condition for allowance in the previous response and therefore no changes are made to the present claims. Further, Applicant has responded to any new comments made by the Examiner in this response. In addition,

Applicant has submitted a copy of a newly discovered 2009 article (Ravilious, K. *Salt Solution: Cheap power from the river's mouth*, 25 February 2009) which refers to the Loeb patent (which appears to be incorrectly stated in the article as a 1973 patent, when, in fact, the patent appears to be the 1975 patent cited herein). This article even further supports Applicant's analysis of the cited Loeb patent because of its reference to "pressure retarded osmosis (PRO)" as providing the energy to drive a power turbine. The reference by the author of the article to pressure as used in Loeb, although not specifically stated. clearly refers to the hydrostatic pressure provided by the external pumps in Loeb, and not the osmotic pressure used in the Applicant's invention. This utilization of the term (hydrostatic) pressure by the author of the article is clearly supported in the Loeb patent in Figs 1, 2a, 2b, 3, 3a, 4, 4a, 5 and 6 and the discussion in Loeb of those figures and the Applicant's remarks above.

It is clear that the author oversimplifies the understanding of the Loeb patent in her use of pressure when it should further refer to Loeb's use of hydrostatic pressure and Loeb's reliance on volume. Because of the "pressure retarded osmosis" referred to in the article, it is further clear that a continuous system is used in Loeb. The up to 12 atmosphere's of pressure is referencing the hydrostatic pressure of Loeb. Further, the author's explanation of Loeb also lacks all of Applicant's claimed steps relating to providing sealed containers and periodic application and removal of pressure.

For these reasons, and in view of the above remarks, all claims in this application are now considered to be in condition for allowance. Allowance of this application is earnestly solicited and Applicant respectfully requests that this case be passed to issue. In the alternative, these remarks even further place this application in better form for appeal.

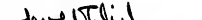
The Director of Patents and Trademarks is authorized to charge any fees, including the two-month extension fee, or to credit any overpayments, to Deposit Account No. 03-2410, Order No. 41056-101.

In accordance with Section 714.01 of the M.P.E.P., the following information is presented in the event that a call may be deemed desirable by the Examiner:

JACOB N. ERLICH (617) 345-3255

Respectfully Submitted,
Irving DeVoe, Applicant

Date: May 8, 2009

By: 
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